MISSION SUPPORT

FISCAL YEAR 2000 ESTIMATES

BUDGET SUMMARY

OFFICE OF SAFETY AND MISSION ASSURANCE
OFFICE OF THE CHIEF ENGINEER
OFFICE OF THE CHIEF TECHNOLOGIST

SAFETY, MISSION ASSURANCE, ENGINEERING, AND ADVANCED CONCEPTS

SUMMARY OF RESOURCES REQUIREMENTS

	FY 1998 OPLAN 9/29/98	FY 1999 OPLAN 12/22/98	FY 2000 PRES BUDGET
		(Thousands of Dollars)	
Safety and Mission Assurance	26,900	25,900	25,400
Engineering	5,900	5,300	12,900
Advanced Concepts	5,000	4,400	4,700
Total	37,800	35,600	43,000

Distribution of Program Amount by Installation

	FY 1998	FY 1999	FY 2000
Johnson Space Center	5,250	7,150	7,100
Kennedy Space Center	750	735	680
Marshall Space Flight Center	2,095	2,500	1,915
Stennis Space Center	--	125	235
Ames Research Center	6,550	5,985	6,099
Dryden Flight Research Center	200	435	520
Langley Research Center	4,135	4,250	4,623
Glenn Research Center	1,465	1,310	1,873
Goddard Space Flight Center	5,600	6,030	8,630
Jet Propulsion Laboratory	5,823	3,130	7,200
Headquarters	5,932	3,950	4,125
Total	37,800	35,600	43,000

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Program Goals:

NASA's Safety, Mission Assurance, Engineering, and Advanced Concepts (SMAEAC) budget is an investment in the safety and success of all NASA programs. The SMAEAC budget supports the activities of the Office of Safety and Mission Assurance (OSMA), the Office of the Chief Engineer (OCE), and the Office of the Chief Technologist (OCT). These three Offices advise the Administrator, oversee NASA programs, develop Agency-wide policies and standards, and support the technology requirements of NASA flight programs.

Strategy for Achieving Goals:

OSMA ensures that sound and robust processes and supporting tools are in place throughout NASA to enable safe, successful missions. OSMA establishes NASA safety and mission assurance (SMA) strategies, policies, and standards and assures compliance. OSMA ensures that SMA disciplines are appropriately applied throughout the program life cycle. The office also provides analysis, oversight, and independent assessment (IA) of programs and flight and ground operations to ensure that suitable attention is placed on risk mitigation, that missions are conducted safely, and that there is a high probability of mission success. OSMA sponsors research, development, pilot application, and evaluation of tools, techniques, and practices that advance NASA's SMA capabilities. It also funds SMA training course development and independent assessment of the Human Exploration and Development of Space (HEDS) enterprise. Software assurance efforts develop, test, and evaluate methods to assure the performance and safety of critical flight, ground control, and robotics system software.

The OCE oversees NASA's strategic crosscutting process to "Provide Aerospace Products and Capabilities" and independently evaluates ongoing programs, proposed concepts, and options for new programs. The OCE establishes policies, standards, and technical capabilities to improve NASA engineering practices and supports evaluation and introduction of advanced electronic parts and packaging technology into NASA programs.

The OCT is NASA's principal advocate for advanced technology. As such, the OCT advises the Administrator on technology matters and develops a NASA-wide investment strategy for innovative and advanced technology. The office leads the development of NASA-wide technology goals and objectives and oversees NASA technology policies, programs, processes, and capabilities. The OCT also sponsors the NASA Institute for Advanced Concepts (NIAC), which addresses NASA strategic objectives requiring technology readiness ten to twenty years into the future.

Measures of Performance:

Metric	Description	FY 1998 Results
Mishap Prevention	Contribute to reducing the number of mishaps at NASA facilities and lessening productivity losses.	The FY 1998 lost time due to injury rate decreased 12.5% from FY 1997. NASA's rate is 1/8 that of the entire Federal government and 1/5 that of the private aerospace sector.
Safety and Quality Requirements and Standards	Replace NASA standards with U.S. and international industry standards wherever possible. Develop and maintain NASA standards where required. Emphasize voluntary compliance and adoption of ISO 9000. Reduce cost of procuring flight and ground systems.	OSMA completed revising and reformatting all its NASA Policy Directive Documents, going from 22 documents/149 pages to 13 documents/54 pages. NPD 8730.3, "NASA Quality Management System Policy (ISO 9000)", establishing the Agency's ISO 9000 implementation requirements, and NPD 8621.1G, "NASA Mishap Reporting and Investigating Policy", were issued. Three Centers completed ISO 9000 registration.
Independent Assessments, Oversight, and Reviews	Contribute to the safety and success of NASA missions by ensuring that programs resolve all technical issues prior to flight. Evaluate adequacy of NASA safety, reliability, quality assurance, and engineering capabilities. Assess critical NASA issues, the status of development programs, and technical options for proposed programs to ensure they will reliably and effectively meet mission requirements at minimum cost.	OSMA supported four Shuttle and ten science payload launches. Technical analyses of design decisions by the International Space Station (ISS) IA help ensure future safety and on-orbit performance. The OCE completed 17 Independent Annual Reviews (IARs) of ongoing programs and six Special Assessments of spacecraft programs that resulted in improved program management processes; and established an infrastructure for collaborative engineering. Revised and initiated full implementation of NASA-wide guidelines for Program and Project Management (NPG 7120.5A)
Systems Engineering and Design Analysis	Improve and expand the use of integrated analytic methods to perform the systems engineering analyses required to define and optimize new missions and provide new and improved methods for detailed analysis and test of aerospace systems.	The OCE completed assessment of current approaches to System Engineering Metrics and Risk Management processes and developed a System Engineering Tools baseline for NASA program use. OCE improved the flexibility of the NASGRO software tool for crack growth estimation and expanded an industry-government user group to support broader external use of the tool. OCE also demonstrated capability of combined dynamic testing of spacecraft to reduce testing cost and risk of damage to flight hardware, continued development of STEP (Standard for the Exchange of Product Data) data interchange protocols for control systems, and established a test bed to demonstrate STEP applications

Metric	Description	FY 1998 Results
Engineering Standards and Practices	Improve the technical guidance available to NASA programs and integrate with commercial practice to increase commonality and interoperability through an Agency-wide standards system; accelerate adoption of voluntary consensus standards.	The OCE integrated SMA, information technology, and engineering standards into NASA-wide Preferred Technical Standards Management System and Database. The OCE completed three new NASA Standards, adopted over 400 voluntary standards, and eliminated an equal number of installation standards and requirements for Government standards while implementing Office of Management and Budget Circular A-119.
Technology Leadership Council (TLC)	Ensure NASA-wide coordination of emerging technologies critical to future missions.	Held two TLC meetings during FY 1998 to establish Agency directions and priorities. Results included assessments of NASA's management process and investment strategy for long-range critical technology and specific recommendations for meeting shortfalls and needs.
Non-Destructive Evaluation (NDE)	Develop and certify improved NDE methods for aerospace manufacturing and operations. Reduce manufacturing and test costs by reducing teardowns, scrappage, and replacements caused by destructive testing.	OSMA completed techniques for hydrogen/helium leak imaging, friction stir welding evaluation, and electronics assessment, as well as studies on probability of detection for various NDE processes
Mission Assurance	Help to "maximize the probability of success of NASA missions by using qualitative or quantitative risk assessment techniques to identify and understand the risks, take appropriate steps to control or mitigate the risks, and then accept only reasonable and appropriate levels of residual risk before proceeding with a mission" (NPD 8700.1, "NASA Policy for Safety and Mission Success," paragraph 1.b.).	OSMA incorporated new risk management policy in NPG 7120.5A. This requires program/project managers to identify, analyze, plan, track, and control risks (undesired events such as cost overrun, schedule slippage, safety mishap, or failure to achieve a needed technological breakthrough). A companion Continuous Risk Management training course was developed and piloted to 10 NASA projects; the course continues to be improved and presented throughout NASA. A Quantitative Risk Assessment System (QRAS) software application was developed and demonstrated. Its initial purpose is to evaluate the risk benefits of proposed Space Shuttle upgrades (in reducing the probability of catastrophic mishap); its long-term purpose is to assess risk for NASA missions. Risk-based assessments were conducted on major NASA programs including Shuttle-Mir, Space Flight Operations Contract, X-33, X-34, X-38, and Super Lightweight Tank. SMA conducted Prelaunch Assessment Reviews (PARs) to thoroughly understand and assess the risks leading up to launch, and established the SMA Flight Readiness

		Review (FRR) position for each Space Shuttle mission.
Metric	**Description**	**FY 1998 Results**
Test Effectiveness	Provide environmental test data analyses correlated against flight performance to quantify specific guidance for tailoring test programs to specific mission requirements, thus enabling lower mission development costs for better, faster, cheaper spacecraft.	OSMA completed trend analysis of Cassini Problem and Failure Reports. Developed improved pyroshock testing techniques, including guidelines for program/project test tailoring, and determined the effectiveness of random vibration testing as a workmanship screen. These efforts directly supported the Deep Space-2 program and allowed substitution of impact shock testing for random vibration qualification testing. Successfully integrated and flew the Spacecraft Loads and Acoustic Measurements instrument on the Advanced Composition Explorer (ACE)/Delta mission. Early flight data analysis indicated a conservatism (~ 10dB) in predicted and ground test levels for acoustic and random vibration signatures versus flight levels. Low frequency predictions were less conservative. The Ambient Air (versus thermal vacuum) Test program provided direct support to the Spartan 400 program: scanning electronic breadboards to locate hot spots expedited design activities and obviated the need for board-level thermal analysis.
Electronic Parts and Packaging	Qualify advanced electronic parts and packaging technologies to reduce size and power requirements for space flight systems. Facilitate use of proven components through assistance to ongoing programs and dissemination of information through parts selection databases and guidelines.	OSMA completed reliability assessment and characterization of micro-electro-mechanical systems, direct chip attachment, and compound semiconductor technology. OSMA continued radiation effects characterization of advanced emerging technologies and commercial parts, developed parts selection and utilization aids, and standardized processes for electronic parts and packaging evaluation.
Professional Development Initiative (PDI)	Develop training materials to maintain SMA skills in a changing workforce.	PDI's Web-based SMA training system transitioned to a multi-discipline, Agency-wide system, the Site for On-line Learning and Resources (SOLAR), using the PDI infrastructure. PDI Web-based users increased from 923 in FY 1997 to 1,477 in FY 1998 and formal training instances increased from 181 in FY 1997 to 324 in FY 1998. The PDI continued to develop and update instructor and Web-based courses and transition instructor-based courses to the Web where appropriate.

Accomplishments and Plans

In FY 1998, OSMA supported critical agency SMA infrastructure in order to maintain safety and mission success despite decreased Agency resources and changed business practices. Safety and mission assurance requirements specific to the new environment of "better, faster, cheaper" missions were addressed. Oversight of the Shuttle and Space Station programs was maintained. OSMA began full funding of the ISS IA effort, which supports launch readiness decisions.

New tools, techniques, and procedures, combined with process verification data and techniques that ensure process stability and capability, allowed process verification insight to replace audit-based oversight. Assurance for "better, faster, cheaper" missions moved from "rule-based" to "knowledge-based" approaches. The QRAS software application was developed for use in evaluating the risk benefits of proposed Space Shuttle upgrades. The Single Process Initiative, ISO 9000, and performance-based contracting supported acquisition reform goals of efficiency and effectiveness. OSMA supported the consolidated NASA ISO 9000 registrar contract for Center certification. The PDI provided essential, high quality instructor-based training in safety and quality assurance via the NASA Safety Training Center and the Workmanship Standards Training Centers. The PDI website infrastructure transitioned to a multi-discipline Agency system, SOLAR. The Continuous Risk Management course was piloted to ten project teams. Four Shuttle flights and ten major payload launches were supported. Shuttle Flight Operations Contract performance was evaluated.

NASA Policy Directives 8730.3, "NASA Quality Management System Policy (ISO 9000)", establishing the Agency's ISO 9000 implementation requirements, and NPD 8621.1G, "NASA Mishap Reporting and Investigating Policy", describing a consolidated policy for mishap reporting and investigating, were issued. Multiple existing NASA standards for safety and quality assurance were updated, reformatted, and reissued to conform with the Agency's new technical standard format. OSMA launched a major effort to expand the use of risk management philosophies and techniques throughout the NASA program management structure. This effort paralleled issuance of the revised NASA Policy Guidance (NPG) 7120.5A, "Program and Project Management Processes and Requirements".

The test effectiveness program and techniques for trading risk enabled informed test planning for "better, faster, cheaper" missions and improved risk management while reducing costs. Actual load, acoustic, and vibration environment measurements were made on the expendable launch vehicle for the ACE mission. Actual loads were up to 10dB less than the predictions used for design and test. Ambient air thermal testing on Spartan 400 breadboards replaced board-level thermal analysis and expedited the design. Improved pyroshock testing and random vibration workmanship screening allowed the Deep Space-2 program to eliminate random vibration qualification testing. Data on Cassini Problem and Failure Reports was correlated by cause, test type, and level of assembly.

Advanced, unique NDE techniques were developed to support less costly and longer life aerospace components. They included hydrogen/helium leak imaging, friction stir welding, electronics, and studies on probability of detection.

The Software Assurance program researched, developed, piloted, and evaluated additional standards, tools, techniques, and processes. This ongoing effort improved NASA's ability to ensure the safe and reliable performance of mission-critical software. Areas of emphasis included lifecycle risk, several safety issues, formal methods, and a reusable test bed. OSMA funding also supported operation and maintenance of the Fairmont, WV, Independent Verification and Validation (IV&V) facility.

In FY 1998, the OCE conducted 17 IARs for ongoing programs to ensure they were meeting technical and resource commitments, completed an assessment of the Mars Surveyor 2001 program, and completed six Special Assessments including the Laser Altimeter Satellite and Fastrac Engine. NPG 7120.5A revisions clarified and unified Agency-wide program/project management process requirements. A basic interactive infrastructure for Collaborative Engineering was installed in FY 1998 and is already being used to conduct real time cooperative design and analysis among NASA Centers.

In FY1998, the OCE initiated a Space Transportation Architecture Study, funded by the Office of Aerospace Technology, to assess alternatives to meeting NASA's need for human space flight through the year 2020 while achieving significant reductions in cost. When the study is completed, NASA will assess the results.

The OCE has established a unified NASA Preferred Technical Standards System to support sharing of best practices, promote interoperability of design, and to increase use of Voluntary Consensus Standards (VCS) as directed by PL104-113. Over 400 VCS were formally adopted in FY1998. Systems engineering activities completed development of a tool to integrate design requirements and verification information, and continued development of space system specific Application Protocols for ISO 10303. The tool, known as STEP - Standard for the Exchange of Product Data, is a potentially major enabling element for system-independent sharing of engineering data and distributed engineering collaboration. A combined dynamic testing task was initiated to significantly reduce structural testing requirements, both saving program dollars and lowering the risk of test damage to flight systems. Upgrading the NASGRO crack growth estimation software improved applicability to real-world situations, and a growing user group is extending use of the tool in the aerospace industry. Testing of Mars Observer pyrotechnic valves and a joint program on Advanced Airbag Technology Assessment with the Department of Transportation were completed as scheduled. Results will improve the effectiveness of future programs.

In the area of Electronic Parts and Packaging, product assurance support for "Instruments on Chip" will help lead to dramatically lighter and lower power electronics. Radiation screening for newly qualified parts and technology readiness guidelines for inserting rapidly emerging semiconductor technology into microspacecraft continued to improve mission reliability. Development of "selection tools" for commercial-off-the-shelf devices for "better, faster, cheaper" spacecraft and instruments, as well as assurance for micro-electro-mechanical devices also supported improved reliability. Results from evaluations of different vendor technologies for multi-chip modules, plastic encapsulation, micro ball-grid array packaging, direct chip attachment, analog to digital converters, active pixel arrays, and digital signal processors were disseminated via the world-wide-web. Electronic Parts and Packaging transfers from OSMA to the Office of Space Science for FY 1999.

In FY 1998, the OCE and OCT began a two-year study by the National Research Council (NRC) on Advanced Engineering Environments to assess NASA's current engineering capabilities and plans against the current best practices and projected advances in the state-of-the-art. The results of this study will be used to help guide NASA in implementing the Agency's vision for how future missions will be conceived, designed, developed and operated. A first-generation infrastructure has been established to assess the potential of available capabilities to perform distributed, collaborative engineering on current programs. The Intelligent Synthesis Environment (ISE) includes a Collaborative Engineering capability.

In FY 1998, the OCT supported a long range Agency-wide activity to revolutionize the way NASA plans, analyzes, and develops future programs. The OCT held two meetings of the Technology Leadership Council during FY 1998 to establish Agency-wide directions and priorities. The TLC serves as a forum for reviewing Agency policies, priorities, practices, and issues and coordinating the development of integrated strategic technology plans. Significant results of these meetings included assessments of NASA's management process and investment strategy for long-range critical technology with specific recommendations for meeting shortfalls and needs**.** In the summer of FY 1998, the OCT initiated the NASA Institute for Advanced Concepts (NIAC) through an open competitive process and selected 16 proposals. The Institute issued its first solicitation in the summer of FY 1998 for initial award by the end of the fiscal year. The NIAC concepts will complement the advanced concepts activities conducted within the NASA Enterprises. The NIAC will focus on revolutionary systems and architectural concepts that may have a major impact on future NASA missions.

In addition, the OCT developed plans to initiate the ISE program to revolutionize the way NASA develops its programs from concept through disposal, encompassing the entire program life cycle. Critical ISE activities will examine emerging technology advances in high data rate communications and networks, high performance computers, advanced human-computer interfaces, massively distributed data systems, advanced analysis methods, and the use of complex immersive environments for collaborative teaming. Ultimately, these capabilities will enable widely distributed groups of experts covering diverse areas of science, technology and engineering to work as a highly integrated, virtually co-located team.

OSMA assumes management and funding of contracted Shuttle IA efforts from the Office of Space Flight in FY 1999. The ISS IA continues to support the ISS program and OSMA flight readiness decisions. Six Shuttle and ten major payload launches will be supported. Activities to update and streamline standards and policies continue. The QRAS will be enhanced with more data and a more friendly user interface. SMA organizations will provide risk management implementation consultation, ensuring that NASA's program managers have the philosophy, tools, guidance, and expertise to make informed choices among technical, schedule, and cost risk. The PDI, as part of SOLAR, continues developing skills training modules to help maintain and improve SMA workforce skills. Significant usage increases are forecast as SOLAR provides mandatory training that was formerly instructor-based. The remaining eight NASA Centers will complete ISO 9000 certification, and the White Sands Test facility, registered in FY 1995, will undergo a tri-annual registration update.

OSMA begins an effort in human reliability to reduce risks inherent to human interaction with NASA's complex, fast-moving, high-reliability operational management systems. Tasks include standardizing close call reporting in NASA's incident reporting system, reviewing incidents for human reliability issues, and developing a human reliability training module. Test effectiveness efforts are restructured into a broader scope of failure detection and prevention. The failure prevention and detection program will increase the probability of success of NASA aeronautics and space flight projects. This will be accomplished by developing methodologies for identifying and balancing risk; providing the tools and techniques to enable projects to develop and implement effective, tailored mission assurance programs; providing the tools and techniques to enable projects to reliably infuse new technologies and heritage hardware; and integrating products into the Collaborative Engineering Environment (CEE) element of ISE. NDE efforts in X-ray imaging, pyrovalve seal evaluation, silicon carbide-based sensors, and neural-net processed holography begin; while work on methods for graphite-epoxy composites and eddy current corrosion detection continue. In the metrology and calibration area, a very low- pressure primary standard and in-place accelerometer calibration technique will be completed.

Beginning in FY 1999, operations and maintenance responsibility for the Fairmont, WV, IV&V facility resides with the Office of Aerospace Technology. This transfer completes the facility's transition to a component of the Ames Research Center. OSMA funding supports continued development of standards, tools, techniques, and processes as well as pilot application and evaluation activities. Transferring technical guidelines to software developers will help to ensure that safety and quality are built into critical software from the beginning.

In FY 1999, OCE support for IARs of ongoing programs will continue at the same level as FY1998. Six assessments are planned for FY 1999, including the Space Station Crew Return Vehicle, Next Generation Space Telescope, and New Millennium Deep Space-3. Additional Special Assessments will include a Liquid Flyback Booster Cost Assessment Study. Continued development to expand a distributed engineering infrastructure, funded under the ISE, will improve access to expertise for assessments. The NASA Space Transportation Architecture Study will be completed.

The OCE will complete adoption of currently used Voluntary Consensus Standards and accelerate replacement of NASA standards where alternatives exist. Plans include expanding standards development in cooperation with national standards organizations, completion of several new NASA standards to meet unique needs, and completing incorporation of all NASA standardization areas in the NASA Preferred Standards system. Participation in the development and negotiation of international standards for space systems and operations will continue through ISO Technical Committee 20/Subcommittee 14, Space Systems and Operations.

In systems engineering, the OCE will demonstrate analysis tools to evaluate the effect of uncertainty on system operation, extend use of the STEP data exchange standard to thermal analysis, integrated Product Data Management, and the overall systems engineering process. The OCE will implement a systems test bed to assess use of STEP for integrated product data management and transfer of multi-disciplinary design data among design centers. The initial phase of the NRC evaluation of Advanced Engineering Environments will be completed.

Space Shuttle flight validation of the force-limited vibration testing method is scheduled for May 1999. Related activities in FY1999 include development of design guidelines for advanced structural concepts including inflatable structures and integrated electronic/structural elements being considered for advanced missions.

In FY 1999 the OCT will continue to hold meetings of the TLC to assess NASA's technology development program and provide recommendations on guidelines, priorities and other ways to improve the full range of technology development activities. The NIAC will continue to fund proposals selected in response to its FY 1998 solicitation, and will issue at least one new solicitation for proposals during FY 1999. The OCT will also fund special studies and internal activities focused on specific issues relevant to the OCT's responsibilities to assess and document Agency technology development activities, identify new technology opportunities, and guide future technology planning.

Also during FY 1999, the OCT will oversee the development of NASA's detailed plans to fully initiate the Intelligent Synthesis Environment vision in FY 2000. NASA will acquire the basic hardware and software systems to enable practical, state-of-the-art operation within a distributed, collaborative science and engineering environment. The OCT will begin establishing testbeds to guide and validate new ISE technology for NASA's specific needs. New partnerships with other government agencies and industry will leverage substantial external ISE-related investment. The OCT will begin pathfinding R&D activities to guide long-range development plans.

In FY 2000, the ISS and Shuttle IAs will support OSMA flight readiness decisions. ISS IA data will also assist the ISS program. Eight Shuttle and seven payload launches will be supported. Instructor-based SMA training courses will be converted to Web-based, and an NDE training module will be developed. System and operational safety efforts will include earthquake preparedness, voluntary hydrogen/oxygen standards, and composite overwrapped pressure vessel damage and aging issues. Operation of the Incident Reporting Information System (IRIS) and NASA Safety Reporting System (NSRS) continues. OSMA will fund Interagency Nuclear Safety Review Panel (INSRP) analysis for upcoming Mars and deep space programs that use radioactive sources.

The human reliability effort will test and implement mishap and human error countermeasures at Kennedy Space Center (KSC) in FY 2000. Modified incident reporting systems, enhancing the reporting of close-call incidents, will be operational and a human reliability Web-based training module will be on-line. Human reliability-based mishap and incident investigations and other assessments will identify the root cause of any incidents or mishaps during the intense Shuttle operations for on-orbit assembly of the International Space Station. The human reliability effort will contribute to maintaining a high level of safety in Shuttle and Space Station operations. Human reliability lessons learned will begin to be applied to NASA programs and projects outside of KSC.

Risk management efforts will continue to focus on implementation of risk management methodologies and tools by NASA programs and projects, with SMA providing expert consultation and facilitation. The Continuous Risk Management training course will be fully operational, with portions integrated into program and project management training. Each Center will have SMA staff qualified to present the course.

The tools, techniques, and results produced by the failure prevention and detection effort will enable aeronautics and space flight programs and projects to develop and implement effective, tailored mission assurance programs and reliably infuse new technologies and heritage hardware into new systems designs. Tools, techniques, and results will be integrated into the CEE.

NDE techniques for micro-electro-mechanical systems, optical and x-ray sensors, and residual structural stresses will be completed. Metrology and calibration efforts continue to develop techniques for NASA's unique measuring needs while reducing calibration costs.

Software assurance efforts will continue to develop, pilot, and evaluate tools, techniques, and processes to assure critical flight and ground software. OSMA's activity is the only effort in NASA developing software assurance capabilities.

IAR's of ongoing programs and Special Assessments of potential new programs will continue with the advantage of increased capability for use of agency-wide expertise using the collaborative engineering capabilities developed through the ISE, systems engineering and the design, analysis and test methodology program elements of the OCE program.

Emphasis will be placed on meeting NASA standardization needs through cooperative initiatives with national and international standards developers except in unique cases. Further elimination of unique Government standards will focus on harmonizing internal process standards to enhance interoperability within NASA and with commercial and international partners. Systems engineering and design analysis activities will focus on implementing priority areas highlighted by results of the National Research Council's Advanced Engineering Environments study to build capabilities needed for full implementation of the ISE. In FY 2000, the OCE will complete guidelines for combined dynamic testing and 3D nonlinear fracture analysis in structural systems, and initiate development of guidelines for integrated design methods to improve concept evaluation of new systems.

The Electronic Parts and Packaging program transfers from the Office of Space Science to OCE for FY 2000. The program will continue evaluation and risk assessment of advanced electronics. The use of qualified and characterized advanced commercial electronic components will reduce costs and shorten development times. Technology evaluations will include advanced microprocessors, microminiaturization packaging technologies, high-density electronic substrates, commercial-off-the-shelf (COTS) memories and processors, and low voltage electronics. Increased funding will support Enterprise needs to assess reliability of emerging photonics and optoelectronics, non-volatile memories, advanced passive and active components, high density electronic substrates, high density part-attach technologies, and radiation effects in low power devices and board-level technologies. These activities will provide increased functionality with less cost, accelerate the use of commercially available electronics technologies, increase attention to radiation-induced failure modes and low temperature electronics issues, and advance microminiaturization. An improved Web-based capability will efficiently support agency-wide needs for information on electronics.

In FY 2000 the OCT will continue to hold meetings of the TLC to review NASA's technology development program and provide recommendations on guidelines, priorities, and other ways to improve the full range of technology development activities. The NIAC will continue its FY 1999 studies and issue at least one new solicitation for proposals during FY 2000. The OCT will also fund special studies and internal activities focused on specific issues relevant to the OCT's responsibility to assess and document Agency technology development activities, identify new technology opportunities, and make recommendations to guide future technology planning.

In FY 2000 the OCT will oversee implementation of NASA's detailed plans to implement the ISE vision. Activities will focus on establishing R&D and application testbeds focused on NASA's specific needs to guide and validate new ISE technology. Cooperative partnerships with other government agencies and industry will leverage substantial external ISE-related investment. Long range, broad-based R&D activities will be initiated, encompassing the following: 1) advanced analysis and simulation methods, 2) life cycle integration and validation, 3) collaborative engineering, 4) intelligent computing/networking, and 5) internal/outreach activities aimed at changing NASA's overall engineering culture to embrace ISE concepts. All activities will actively involve other government agencies, industry and academia.